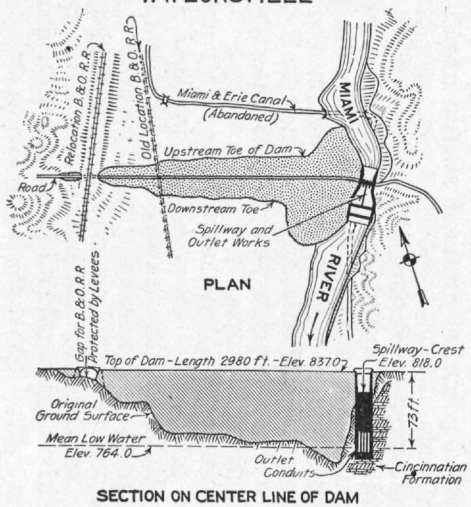
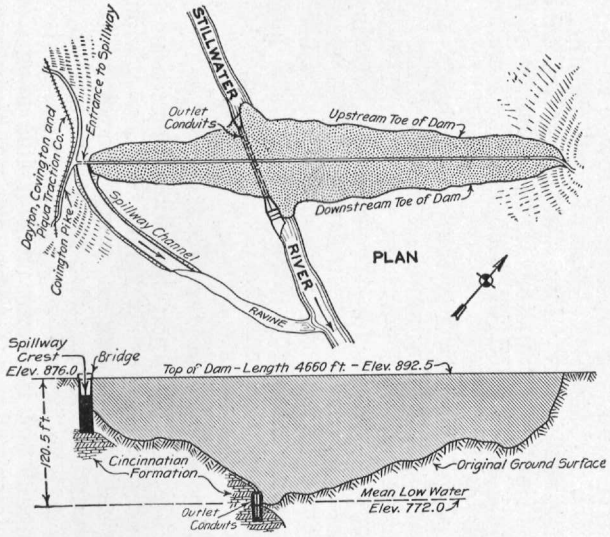
TAYLORSVILLE



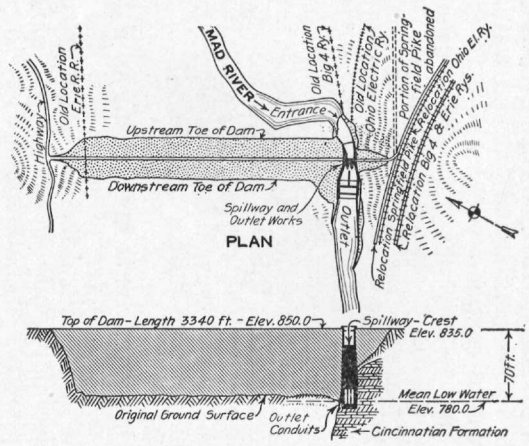
SECTION ON CENTER LINE OF DAM

ENGLEWOOD

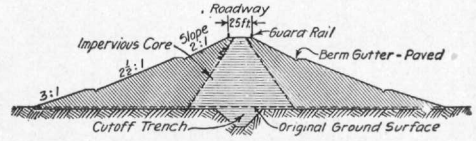


SECTION ON CENTER LINE OF DAM

HUFFMAN

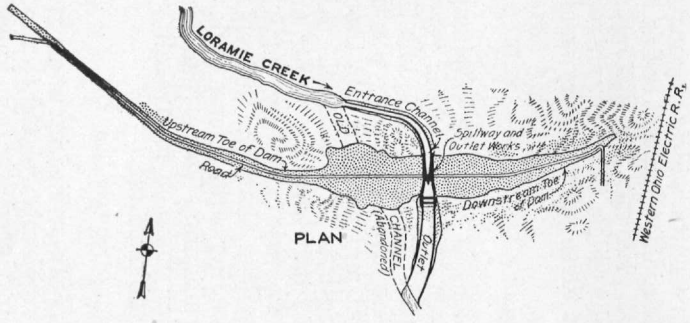


SECTION ON CENTER LINE OF DAM



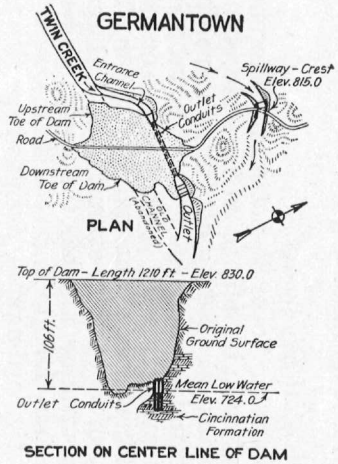
TYPICAL CROSS SECTION OF DAM

LOCKINGTON



SECTION ON CENTER LINE OF DAM

GERMANTOWN



SECTION ON CENTER LINE OF DAM

State of Ohio

The Miami Conservancy District

PLANS AND SECTIONS OF DAMS

SCALE OF PLANS

400 0 400 800 Ft.

SCALE OF CENTER LINE SECTIONS

Horizontal

400 0 400 800 Ft.

Vertical

40 0 40 80 Ft.

SCALE OF TYPICAL CROSS SECTION

Horizontal

40 0 40 80 Ft.

Vertical

40 0 40 80 Ft.

JUNE 1919-L.D.

A Visit to the Miami Conservancy District

By PROF. F. H. ENO, *Dept. of Civil Engineering*

On the morning of March 31st, last, a jolly party of civil engineering seniors, two architects and two civil engineering instructors left the Union Station at Columbus for a visit to the Miami Conservancy District, at Dayton, Ohio. The day was clear and warm. Professor Sherman was many times praised for his success for choosing such a perfect day. Mr. Phillips, Assistant Engineer for the district, met us at the depot with a "fliver" and an improvised motor truck, "limousine." We were first taken to the District office where Prof. S. M. Woodward, of Iowa University, Consulting Engineer to the Conservancy Board, explained to us something of the general scheme of the Conservancy flood protection plans and particularly about the features we were to visit at the Taylorsville and Englewood dams. As the party could spend but one day in the District it was decided that the greatest range of activities could be seen by visiting the two dam-sites mentioned above.

Englewood dam is situated on the Stillwater river about nine or ten miles northwest of Dayton. It is 4660 feet long, 122 feet high and will contain 3,500,000 cubic yards of earth when completed.

The Taylorsville dam is about the same distance due north from Dayton and about seven miles east of Englewood, lying across the Miami river. This dam is 2980 feet long, 78 feet high and will contain 1,235,000 cubic yards of earth.

Mr. H. R. McCurdy, Division Engineer, met us at Englewood and c onducted us over the work. Due to the late start we barely had time to inspect the twin tunnel outlet before the dinner bell called us to lunch at the company mess house. For fifty cents we were furnished with a very substantial and tasty meal, which we were told was in no wise varied from the regular menu for our benefit. While the crowd is busy with the meal I shall improve the opportunity to give a brief history of the development of this immense project from the 1913 flood to the present time.

Immediately following the flood Governor Cox appointed a flood relief committee with Mr. John Patterson, of Dayton, as chairman. This committee rendered heroic and herculean services in succoring and restoring stricken Dayton to something like livable conditions.

On April 12th, 1913, the flood committee at Troy, Ohio, wrote Mr. Patterson suggesting that a permanent organization be effected to plan and perfect a permanent flood protection. On April 20, Mr. Patterson called a general meeting at which time several strong committees were appointed; one on flood prevention, one on finance, another on public improvements, etc. Through the activities of these committees the Morgan Engineering Company was engaged on May 5, and later, on May 27, the Miami Valley Flood Prevention Association was formed. At Mr. Morgan's suggestion, Professor Daniel W. Mead of Wisconsin and S. M. Woodward, of Iowa University, were engaged as Consulting Engineers. They were empowered to select a third. They chose Mr. John W. Alvord of Chicago.

On January 17, 1914, the consulting engineers made a progress report stating that three methods of flood protection were possible, namely:

1. "Channel improvement, including levees, to provide for the safe passage of floods."
2. "Reservoirs for the partial or entire retention or delay of flood waters until they can be safely and slowly released."
3. "Such combination of channel improvements and flood reservoirs as the local conditions may render most practicable."

They found scheme number one would be too expensive and recommended the adoption of number three subject to any revisions that further data might show to be necessary.

In March, 1914, a special board of eight consulting and hydraulic engineers was engaged to examine and report on the plans. This board reviewed the plans carefully and reported on March 26, 1914. It endorsed the recommendations of the three consulting engineers, approving the detention reservoir plan with supplemental channel improvements.

In passing permit me to call attention to the great care and business acumen with which the citizens of Dayton proceeded to plan for flood protection. Most cities object to any considerable expense for engineering services, but the Dayton people with great wisdom elected to pay thousands of dollars for the best experts they could employ in order to know positively whether they were expending their millions wisely and well.

Improvements covering such extended territory and such varied interests are apt to meet many obstructors. In order to provide wide freedom of action, fair but not arbitrary methods of procedure, and prevent unfair obstructions, a new law was asked of the state legislature and after full and complete hearing was enacted. After many stormy scenes in the courts of Miami valley and an attack in the legislature to emasculate the law, the Miami Conservancy District, comprising portions of nine counties and including the cities of Piqua, Troy, Dayton, Miamisburg, Middletown and Hamilton was established in June, 1915.

Under the conservancy law the improvements were to be paid for by special assessments levied against the property according to benefits. The appraisal of benefits and damages, and levying of assessments was a great task and took the committee, with one or two hundred employees, nearly two years to complete. This appraisal was filed May 9, 1917, and amounted to $77,234,668.00 and covered 65,000 pieces of property. Of this number 60,000 pieces were benefited and 5,000 pieces were allowed damages.

The estimated cost of the flood prevention works including 10% for contingencies was placed at $27,804,000, or about 36% of the appraised benefits.

The items composing the total estimate were as follows:

Real estate and easements	$ 7,150,000
Cost of flood control works	12,145,000
Public Service relocations and damages	3,550,000
Administration and general expenses	1,900,000
Taxes and special assessments during construction	200,000
Incidentals and contingencies	2,859,000
Total	$27,804,000

Bids were asked, to be submitted on November 15, 1917, on some 58 or 60 contracts. Seven construction companies submitted bids. Due to the unsettled war conditions the prices named were all higher than the engineer's estimates.

On December 3, 1917, all bids were rejected except one upon contract number 41 and the board of directors voted to proceed to do the work by force account.

The final plans upon which work is now proceeding consists of a series of five retarding basins formed by dams built across the valleys of the Miami, Mad and Stillwater rivers and on Twin and Loramie creeks. Each dam will have permanent openings through its base through which the river at ordnary stages and during small freshets will flow unimpeded. When large floods occur the water which can not pass these openings will pond up behind the dam and will gradually run out after the storm has spent its fury.

Supplementing these claims there will be a straightening and widening of the river channels through the various cities along the rivers, with additional embankments and revetments to insure greater safety.

It was estimated that 1,415,000 acre feet of water fell during the March, 1913 storm, over the drainage areas above the proposed dams. "The total caapcity of the retarding basins to the spillway level is 840,000 acre feet, or 60 per cent of the total rainfall" as noted above.

The construction of the five dams will require the moving of about 9,000,000 cubic yards of earth and the placing of 190,000 cubic yards of concrete.

This is the largest project for flood protection in which detention reservoirs have been used. There are several smaller projects in Germany in which this method was employed, but none even approximating the size of the Dayton works.

Some of the details of this immense piece of engineering are well worthy of consideration.

Hydraulic Fill. The dams are being constructed by the hydraulic fill method, two variations of this method being used. At the Englewood dam, the earth is being excavated by the dragline and Lidgerwood machines and filled into dump cars, hauled to the hydraulic pumping stations located along the back slope of the dam, dumped into the "hog boxes," and then by giant hydraulic jets the earth is washed through revolving screens into the suction pits of the large centrifugal pumps. These pumps suck up the liquid mud and gravel and discharge the mass through 15 or 18 inch steel pipes on to the top of the dam. Small dykes are maintained along both the outer and inner faces of the growing dam, thus preventing the escape of the water and gravel delivered by the pumps. The coarse gravel and heavy material are deposited near the outlet from the pipe in a flat cone. The finer gravel and sand are carried further toward the center of the dam by the water, and the clay and mud are finally deposited in the pool of quiet water maintained along the center line of the dam for that purpose. This is maintained at a given width at any level of the dam by controlling the outlet of the drain used to remove the water after it has performed the work of carrying and depositing its load of gravel and mud. The deposit of mud made in the pool is the impervious core of the earthern dam.

The great advantage of the hydraulic method of building earth dams is that the water sorts the material and deposits it in the best form to accomplish the desired results. The coarse gravel is deposited on the outer slopes of the dam, the

finer gravel and sand being carried toward the core, while the impervious clay and mud properly controlled by the width of the pool, are deposited for the center core of the dam. Material brought on to the dam in this way is also left in a more compact mass than if dumped from cars or cables. By this method of transporting material, the continual moving and rebuilding of industrial tracks for the dump cars is also avoided

On the Taylorsville dam the hydraulic method is used both to excavate and carry the earth. The "Giants" as the hydraulic nozzles are called, are used to cut the gravel and clay out of the hillside and the water carries the debris through the sluice ways to the centrifugal pump stations, thence the process is similar to that employed at the Englewood dam. The gravel and sand deposits made on either side of the "pool" on top of the dam are known as "beaches." In Fig. 2 is shown a very fine view of the character of this beach deposit. This picture also shows the steel pipe used in the work, the "pool," the opposite "beach" and the dyke on the opposite face of the dam.

Pressure Cells. The dam is composed as previously described of two parallel embankments of sand and gravel with a broad wedge of clay and silt "sandwiched" in between them. The gravel embankments give weight and stability to the dam while the clay core gives impreviousness to it. This central core wall being composed of fine silt and water is more or less liquid and mobile until the water is all drained out of it. With its great specific gravity it brings a considerable pressure on the gravel embankment and tends to slide it out at the base. In order to determine the rate of solidification in the interior of this core wall and to find pressure developments, two methods are used. One, a 6-inch cast iron ball attached to a wire is dropped into the "pool" and its rate of settlement in the mud is recorded. The other, a hollow rectangular metal cell provided with a diaphragm face, an electric contact point, and a connecting gas pipe, so that by pumping in air, under pressure the diaphragm face of the cell is forced out against the earth pressing against it until the electrical contact point is freed and records the fact. This gives the pressure being exerted by the more or less fluid core material. These pressure cells can be set so as to obtain both vertical and horizontal thrusts. The gas pipe is carried up as the dam is built and complete records are being kept of the internal pressures.

Flexible Concrete Revetment. One of the interesting details of construction is the flexible concrete revetment used in the channel improvement at Dayton and Hamilton. The river banks and inner faces of some of the levees subject to erosive action from high water are paved with 6 inch reinforced concrete slabs resting against a low sunken concrete wall at the foot of the slope. This wall caps a row of piles driven 8 feet into the ground beneath. From this wall, extending 30 or 40 feet toward the center of the channel, and lying on the flat river bed, is a flexible concrete revetment. It is made of concrete blocks one foot wide and two feet long having two holes running through them edgewise. These slabs are strung on steel cables fastened to the foot wall at the embankment and to a heavy concrete footing at the river's edge. This flexible arrangemet permits a ready adjustment to the surface in case of any under wash.

Conservancy Parks. The Conservancy Board is retaining a portion of the land above each dam which will be held for public park purposes. These areas, for the present, will be kept in their natural state as camping and recreation grounds. The largest park area is at Taylorsville where 1438 acres will be set aside for that purpose. The total area of the five parks is 3456 acres. Several fine pieces of forestry are included in the park areas and at Englewood there will be a lake covering over 100 acres and having several islands dotting its surface.

Camp Community Associations. One other phase of the conservancy work is of interest to us and that is how the Conservancy Board deals with its employees. A happy, contented man will do more work, be more dependable and stay longer than a discontented man. One of the great problems of labor today is the immense waste from the overturn of workmen. In 1914, Henry Ford employed 52,445 men in order to keep a constant force of about 14,000 men at work.

The Conservancy Board picked good camp sites and built bungalows and frame dwellings that were attractive and comfortable. The idea was to have the government come from within the camp or village itself and not be impressed from above. Suggestions were therefore made to the camps to inaugurate some government satisfactory to themselves.

Taylorsville was the first to organize the camp association. A constitution was adopted and five commissioners elected. One each in charge of community service, social service, education, records and finance, and public safety. The commissioner reeciving the greatest number of votes acting as chairman.

At Englewood an old farm house was converted into a Community Club House fitted out for both men and women. A dance room was provided, a place for moving pictures, and various other social and amusement gatherings. Schools were established, domestic science and manual training taught, night schools open to teach foreigners English and a traveling library secured. These things all help to establish an esprit de corps which has been noticeable to a greater or less degree in all the camps.

Progress of the Work. The last complete report of the Board of Directors shows that 42% of the entire project was completed on October 1, 1919.

Public Service Relocations were	78%	complete.
Lockingham dam was	63%	"
Germantown dam was	52%	"
Englewood dam was	34%	"

And so on down the list of various centers. Since then much work has been done probably bringing the work well over half done. At Englewood dam something over 1,000,000 cubic yards of fill out of 3,500,000 had been placed up to April 1, 1920. The total amount of excavation for dams and river channel improvements will amount to about 16,500,000 cu. yds. Probably between 5,000,000 and 6,000,000 have been moved to date.

Inspection Tour. After lunch the party visited that portion of the dam east of the river which had been carried up 50 or 60 feet in height and inspected the unloading and sluicing stations, the discharge end of the pipe lines and the methods of handling the material in the "hog boxes" and along the dykes at the discharge points on the dam.

From Englewood we proceeded to Taylorsville on the Miami river. The first construction observed here was the re-alignment of the Pennsylvania Railway tracks with a concrete viaduct or arch built over them. In the dam at this point about 700,000 or 800,000 cubic yards of earth had been placed. The point of greatest interest was the very large excavation in the solid rock of the Cincinnati Limestone formation on the extreme eastern end of the dam. This was made to receive the outflow tunnels and provide

(Continued on page 28.)

A VISIT TO THE MIAMI CONSERVANCY DISTRICT

(Continued from page 21.)

a stilling basin at the discharge end of the tunnels.

From here we returned to the Dayton offices where each member of the party was provided with copies of the Chief Engineer's Report and sample copies of specifications for one of the dams.

All of the Conservancy officials whom we met were very kind and courteous to us.

I wish to acknowledge my indebtedness to Mr. Morgan and his staff for much of the information contained in this article. The information was taken from "The Miami Conservancy Bulletin" and Mr. Morgan's Reports.